

CLAIMS

We claim:

- 1 1. A method for performing atomic layer deposition, the
2 method comprising:

3 providing a multi-wafer sequential deposition module having
4 a plurality of wafer stations;

5 inserting a plurality of wafers within the multi-wafer
6 sequential deposition module;

7 rotating the plurality of wafers in a sequential fashion
8 among the plurality of wafer stations;

9 depositing at least one monolayer on each of the plurality
10 of wafers at each of the plurality of wafer stations; and

11 rotating a plurality of process gases in a sequential
12 fashion among the plurality of wafer stations to complete the
13 atomic layer deposition on each of the plurality of wafers.

- 1 2. The method of Claim 1, further comprising inserting at
2 least one additional wafer into the multi-wafer sequential
3 deposition module and removing at least one of the plurality of
4 wafers when a desired deposition layer thickness is obtained.

1 7. The method of Claim 1, further comprising flowing an
2 inert gas between each of the plurality of wafer stations to
3 isolate each of the plurality of process gases and prevent
4 undesired deposition.

1 8. The method of Claim 1, further comprising performing
2 conventional chemical vapor deposition within the multi-wafer
3 sequential deposition module concurrently with atomic layer
4 deposition.

1 9. The method of Claim 1, wherein the atomic layer
2 deposition film is formed using at least one of a reactant gas,
3 an ion stream, or a radical stream.

1 10. The method of Claim 1, wherein at least one of the
2 plurality of wafers is biased by delivering electrical power to
3 a substrate holder of the corresponding wafer station.

1 11. The method of Claim 1, wherein a spacing between a
2 showerhead of at least one of the plurality of wafer stations
3 and at least one of the plurality of wafers is set for plasma
4 processing.

1 12. A semiconductor device having a deposition layer
2 formed according to the method of Claim 1.

1 13. A method for performing atomic layer deposition in a
2 multi-wafer sequential deposition module having a plurality of
3 wafer stations, the method comprising:

4 moving a plurality of wafers in a sequential order among
5 the plurality of wafer stations;

6 introducing a first process gas at a first station of the
7 plurality of wafer stations;

8 introducing a second process gas at a second station of the
9 plurality of wafer stations; and

10 rotating the first process gas and the second process gas
11 sequentially to at least the first wafer station and the second
12 wafer station of the plurality of wafer stations to form an
13 atomic layer deposition film on corresponding wafers from the

14 plurality of wafers positioned at the first wafer station and
15 the second wafer station.

1 14. The method of Claim 13, wherein the plurality of
2 wafers receive a portion of a total deposition thickness at each
3 of the plurality of wafer stations that receive the first
4 process gas and the second process gas.

1 15. The method of Claim 13, wherein the first process gas
2 and the second process gas are not diverted from the plurality
3 of wafer stations as the atomic layer deposition film is formed.

1 16. The method of Claim 13, wherein the rotating of the
2 first process gas and the second process gas is performed by a
3 rotary ball valve.

1 17. The method of Claim 13, further comprising flowing an
2 inert gas to each of the plurality of wafer stations that are
3 not receiving the first process gas or the second process gas.

1 18. The method of Claim 13, further comprising flowing an
2 inert gas between each of the plurality of wafer stations.

1 19. The method of Claim 13, further comprising performing
2 a conventional chemical vapor deposition process within the
3 multi-wafer sequential deposition module for at least one of the
4 plurality of wafer stations.

1 20. The method of Claim 13, wherein the atomic layer
2 deposition film is formed using at least one of a reactant gas,
3 an ion stream, or a radical stream.

1 21. The method of Claim 13, wherein at least one of the
2 plurality of wafers is biased by delivering electrical power to
3 the corresponding wafer station.

1 22. A semiconductor device having an atomic layer
2 deposition film formed according to the method of Claim 13.

1 23. A method for applying a deposition layer on a
2 semiconductor substrate, the method comprising:

3 providing a multi-wafer sequential deposition module having
4 a plurality of wafer stations and a plurality of showerheads;

5 inserting a plurality of wafers within the multi-wafer
6 sequential deposition module;

7 flowing one or more types of gas compositions through one
8 or more of the plurality of showerheads; and

9 rotating the plurality of wafers in a sequential,
10 continuous fashion under the plurality of showerheads until a
11 desired thickness of the deposition layer is formed.

1 24. The method of Claim 23, wherein the deposition layer
2 is formed by either an atomic layer deposition process or a
3 chemical vapor deposition process.

1 25. The method of Claim 23, wherein at least one of the
2 plurality of showerheads has a triangular, a delta, or a linear
3 shape.

1 31. The method of Claim 23, wherein a spacing between at
2 least one of the plurality of showerheads and at least one of
3 the plurality of wafers is set for plasma processing.

1 32. A semiconductor device having a deposition layer
2 formed according to the method of Claim 23.